

N70-15047
NASA-107451



MASSACHUSETTS INSTITUTE OF TECHNOLOGY

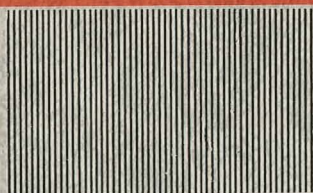
MVLS-69-3

LIFE SUPPORT

IN UNUSUAL ENVIRONMENTS

Principal Investigator ; L. R. Young

November, 1969



Third Semi-Annual Report on
NASA Grant NGR 22-009-312

**CASE FILE
COPY**

MAN-VEHICLE LABORATORY
CENTER FOR SPACE RESEARCH
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

LIFE SUPPORT
IN UNUSUAL ENVIRONMENTS

Third Semi-Annual Status Report on
NASA Grant NGR-22-009-312

MVLS-69-3

November 1969

Principal Investigator: Professor L. R. Young

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Man-Vehicle Laboratory
Center for Space Research

I. INTRODUCTION

The past six months have lead to essentially completed literature surveys in the areas of atmospheres in life support systems, water reclamation, extravehicular systems, and trace contaminant monitoring.

Survey reports in each area are being prepared and reviewed, with the ultimate goal of recommending fertile research approaches suitable for work in graduate school laboratories. The current status in each area is outlined below.

II. ATMOSPHERES

(Prof. R. C. Reid)

In the past six months, Prof. Reid has made the following visits to various meetings and companies to discuss current problems in life support technology. Copies of the trip reports have been forwarded to Mr. J. Pecoraro at NASA Headquarters.

March 1969

Houston Manned Spacecraft Center
and AIChE National Meeting
Symposium on Adsorption
New Orleans, Louisiana

May 2, 1969

Mr. Noel Bannerton
TRW Inc.
Cleveland, Ohio

August 21, 1969

Mr. Terry Secord
Advanced Biotechnology & Power Dept.
McDonnell-Douglas Astronautics Co.
Santa Monica, California

August 22, 1969

Mr. J. Smith
Bioengineering Dept.
Lockheed Missiles & Space Co.
Sunnyvale, California

The visits and literature survey over the past year have lead to the development of a first draft of the report on "Atmospheres in Life Support Systems" by Prof. Reid. The areas investigated are:

1. Storage of Atmospheric Gases
2. Regenerative Carbon Dioxide Removal Systems
3. Carbon Dioxide Removal in Space Suits
4. Recovery of Oxygen
5. Electrolysis of Water

Copies of this report have also been sent to NASA Headquarters. Furthermore, the report has been sent to the investigators on the following list to comment on the contents and recommendations. Some of these reviewers, as shown in the list, also attended the workshop conference on Life Support, November 6, 1969, where we further brought to light critical problems for graduate research laboratories.

List of L.S. Reviewers and Conference Invitees

<u>Name</u>	<u>Reviewer</u>	<u>Invitee</u>
G. L. Drake (Gen. Dyn. Corp.)		x
J. Lovell (Hamilton St.)	x	
E. G. Lyman (NASA Ames R.C.)	x	
R. A. Wynveen (Life Systems Inc.)	x	
T. Secord (McDonnell Douglas)		x
T. M. Olcott (Lockheed)	x	
A. E. Humphrey (Univ. Penn.)		x
W. Guy (NASA Manned S.C.)	x	
D. C. Popma (NASA Langley R.C.)	x	
J. Smith (Lockheed)		x
L. W. Ross (Univ. Denver)	x	
J. E. Clifford (Batelle Mem. Inst.)	x	
J. Zeff (Gen. Amer. Trans. Corp.)		x
R. A. Bambenek (AMGLO Corp.)		x
A. J. Gully (Texas Tech. College)	x	
J. Pecoraro (NASA Headquarters)		x
A. O'Keefe (Nat. Air. Poll. C. A.)	x	
H. Podall (Office of Saline Water)		x
A. F. Forziatti (FWPCA)		x
J. M. Spurlock (Versar Inc.)	x	
A. P. Antony (Adv. Electrochem.)		x
N. W. Snyder (North Amer. Rockwell)		x
R. Martin (NASA Langley R. C.)		x
A. L. Ingelfinger (NASA Headquarters)		x

A final draft of the report on Atmospheres should be in circulation by early 1970.

III. EXTRAVEHICULAR SYSTEMS

(Mr. L. C. Von Renner)

A first draft of the report "Extravehicular Activity: A Review with Recommendations" was completed. It is presently being reviewed by university and industrial experts, and includes a study of a systems approach to EVA; subsystems of Life Support, Power, Communications, Propulsion, Guidance and Stabilization. At least thirty-one distinct problem areas were identified in which university researchers could contribute to advancing the broad, over-all state-of-the-art in this field.

Subject to some slight changes in emphasis, the report should be in circulation by late 1969. The report's brief summary appears below.

Extravehicular Activity: A Review with Recommendations

by

Lonnie C. Von Renner

Summary

The field of EVA, like that of aerospace engineering is multi-disciplinary to the point at which one cannot hope to cover in detail the several broad fields of knowledge upon which this subject is based. Therefore, this is a distant view of extravehicular operations, intended to reveal several broad areas where research is needed to provide an advance to the state-of-the-art. These areas are reiterated below:

Area	Problem
The nature of EVA	1. Standard definition of EVA tasks and timelines. 2. Load transmission device
EVA system approach	1. Non-anthropomorphic suit 2. Definition of optimal system
EVA subsystems	1. Space suit improvement 2. Thermal control, CO₂ removal systems 3. Subjective effort model 4. Postural reflex model 5. Electromyographic control 6. Timing controller evaluation 7. Optimal manual control tech.
Simulation	1. Standard fidelity parameter model 2. Optimal use pattern for existing facilities

IV. CONTAMINANT MONITORING IN ATMOSPHERES

(Mrs. H. L. Galiana)

A literature survey into the areas of biological and chemical trace contaminants in closed atmospheres is now near completion. This investigation has also included the acquisition of written comments and information directly from investigators at Perkin-Elmer, General Electric, Hamilton Standard, Block Eng., Wright Patterson AFB. Other contacts are similarly planned.

A rough draft of the review paper on this subject should be ready by the end of November. The final report on "Contaminant Monitoring Techniques" will be circulated to university laboratories, after suitable review, by early 1970. The report plans to cover the areas of

1. Nature and Sources of Biological and Chemical Contaminants
2. Maximum Allowable Contaminant Concentration Levels
3. Trace Chemical Monitoring Techniques
4. Low Level Biological Monitoring Techniques
5. Conclusions and Recommendations

V. WATER RECLAMATION

(John Tole)

A paper entitled "Water Recovery Systems" has been completed and is being distributed to investigators for critical review. A summary of this paper is given below. The report will be circulated to universities and laboratories as soon as it reaches its final form.

Water Recovery Systems

by

John Tole

Summary

This paper considers problem areas in spacecraft recovery systems which could be studied in university research programs. The areas considered are recovery requirements, potability monitoring equipment, recovery techniques and some fringe areas.

An attempt is made to cover each of these areas in some detail and to suggest promising research topics relevant to the underlying problems. Some of the most important areas for future research appear to be

1. Human water exchange
2. Recovery techniques not involving phase separation
3. Improved membranes for existing phase separation techniques
4. Improvement or elimination of chemical pre-and/or post-treatment
5. Better understanding of microbiological balance
6. Better definition of potability and more effective potability monitors
7. Application of potability monitors and water processing techniques to earth-bound environmental problems

VI. PUBLICATIONS AND THESES
OF THE MAN-VEHICLE LABORATORY, 1969

1. Galiana, H. L., "Ionizing Radiation and Magnetic Fields: A Review of Their Effects on the CNS," MVLS 69-1, February 1969.
2. Kemp, Gordon George, "A VTOL Prediction Display," S.M.E.A.A. Thesis, M.I.T., September 1969.
3. Noggle, Phillip L., "manual Control of Unstable Vehicles Using Kinesthetic Cues," Engineer Thesis, February 1969.
4. Reid, Robert C., "Atmospheres in Life Support Systems," MVLS 69-3, November 1969.
5. Shirley, R. S. and L. R. Young, "Motion Cues in Man-Vehicle Control," Fourth Annual NASA-University Conference on Manual Control, University of Michigan, Ann Arbor, Michigan, March 1968; revised for IEEE Trans. on Man-Machine Systems, December 1969.
6. Young, L. R. and C. Oman, R. Vircks, N. Van Houtte, G. Kemp, "Three Display Techniques at the Man-Vehicle Laboratory," 5th Annual NASA-University Conference on Manual Control, M.I.T., March 1969.
7. Young, L. R. and P. Dinsdale, "Contributions of Roll and Yaw Motion Cues in Manual Control," 5th Annual NASA-Univ. Conference on Manual Control, M.I.T., March 1969.
8. Young, L. R., "On Adaptive Manual Control," Ergonomics, Vol. 12, No. 4, Great Britain, July 1969.
9. Young, L. R., "Vestibular Models," presented at 1969 Joint Automatic Control Meeting, University of Colorado, August 1969.
10. Young, L. R. "The Current Status of Vestibular Models," Automatica, Vol. 5, Pergamon Press, Great Britain, Sept. 1969.
11. Young, L. R. and C. M. Oman, "A Model for Vestibular Adaptation," Aerospace Medicine, October 1969.
12. Young, L. R., "Pursuit Eye Tracking Movements," presented at the Pacific Medical Center Symposium on the Control of Eye Movements, San Francisco, California, November 1969.